While this technique cannot, in general, distinguish acute from old myocardial infarction, it can be very useful in making the diagnosis of noncardiac chest pain in a patient with symptoms suggestive of acute myocardial infarction.

Thallium scintigraphy has also been found useful in the assessment of a coronary artery stenosis visualized on coronary angiography but which may be of equivocal hemodynamic significance. In this setting, a stress-induced reversible defect in the distribution of the artery in question is certain evidence that the lesion is physiologically significant. While a negative test finding does not rule out physiological significance of a coronary lesion, it does decrease the likelihood that significant stress-induced ischemia is occurring with similar levels of stress.

Many experts believe that thallium 201 scintigrams are among the most difficult images in nuclear medicine to interpret competently and consistently. Thus, this procedure is recommended only at those centers where suitable instrumentation and experienced practitioners allow for the strictest standards of quality control.

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Computed Tomography of the Spine and Spinal Contents

RECENT DEVELOPMENTS in computed tomography (CT) have made it possible to carry out consistent diagnostic spinal CT. The current CT scanners allow for accurate localization of the level of section by a cursor with appropriate gantry angulation for the area under study. For example, in evaluating the intervertebral disc spaces, it is possible to angle the gantry through the interspace without including adjacent bony structures. Gantry angulation is also of value in obtaining scans of areas of previous operations or trauma without metallic or other high-density hardware.

Third and fourth generation scanners obtain greater detail within the bony spinal canal. Thinner sections with increased spatial and density resolution produce images with increased anatomic detail. Thin sections (1.5 mm or less) are used to define small nerve roots, vessels and ligaments in the spinal canal.

While newer body scanners produce images in 10 seconds or less, the maximum surface dose per slice is approximately 5 to 7 rads, depending on the technical factors. The dose for a series of scans abutting each other increases by about 20 percent.

Of equal importance to the equipment advances is the introduction of metrizamide (Amipaque) for carrying out conventional myelography. This nonionic water-soluble contrast medium has extended the application of spinal CT scanning to allow consistent documentation of the spinal subarachnoid space and the spinal cord. A metrizamide myelogram alone may be inadequate or equivocal; however, a diagnostic CT scan can be done up to four hours after the myelogram.

The Society for Computed Body Tomography has reviewed the indications for spinal CT, dividing them into three types. Type I examinations (no contrast medium) are done in cases of suspected disc herniation, facet joint hypertrophy or spinal stenosis. Unenhanced CT is useful for identifying fractures or for localization for CT-guided biopsy or aspiration procedures. Conventional spinal CT is an ideal alternative to myelography in patients who may have allergy to contrast agents or who may have arachnoiditis.

Type II examinations use diluted intrathecal metrizamide (5 to 7 ml of 190 mg iodine per ml), while type III examinations use concentrated metrizamide injected for conventional myelography followed by CT. Type II and type III examinations are indicated for patients with congenital dysraphic abnormalities, including cases of overt meningoceles or meningomyeloceles or cases of occult dysraphism in which there may be a fatty tumor or intraspinal meningocele tethering the spinal cord. The intraspinal component of lesions can be identified with great precision by metrizamide-enhanced spinal CT. Cases with bone destruction or erosion also can be well examined by CT. The full extent of masses can thus be defined simultaneously whenever the lesions are both intra- and extraspinal.

In cases of cord atrophy or cord expansion, conventional myelography may not precisely define the size of the cord. However, metrizamide-enhanced spinal CT will clearly show and measure

the degree of atrophy or enlargement. At the level of the foramen magnum, intraspinal masses or masses extending intracranially are best examined by metrizamide-enhanced CT.

Finally, CT permits evaluating results of surgical operations as well as changes occurring in the spinal canal. In patients receiving radiation therapy, CT is used to define the treatment ports and to document the results of irradiation.

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Metrizamide Myelography

IN THE SHORT TIME that metrizamide (Amipaque) has been available in this country, it has greatly changed how myelography is done. This highly versatile agent may be used with conventional filming, tomography, or computed tomography (CT) to give diagnostic information which was not readily available with isophendylate (Pantopaque).

The advantages of metrizamide stem from its physical properties. Being water-soluble, it will penetrate narrow spaces and, thus, is a better agent for outlining nerve root sleeves and spaces about tumors and for showing the spinal cord near sites of compression. The necessity of mixing the contrast agent with its diluent immediately before myelography appears inconvenient, but is advantageous in allowing the operator to tailor the concentration precisely to the desired study. The gravitational layering effect works well to fill dependent nerve root sleeves early in the study while the mixing of metrizamide with cerebrospinal fluid, which results from patient motion, can be used to outline the spinal cord in later phases of the study. Because the contrast agent need not be withdrawn, it may be injected into areas from which withdrawal would be impossible, such as in the spinal canal above a thoracic block. Arachnoiditis following the use of metrizamide is virtually unknown; therefore, this contrast agent may be used in situations in which one would hesitate to use isophendylate, such as in cases of trauma and suspected arachnoiditis.

Metrizamide also has its disadvantages. The myelography must be planned in such a way that the contrast agent is moved gently from one region to another, avoiding excessive mixing that can rapidly dilute the agent to the point of being barely visible. Also, it may be difficult to examine the entire spinal canal without using large amounts of relatively high concentration, which increases the chances of side effects. Headache and nausea seem to be more prevalent after metrizamide myelography than after isophendylate myelography. Confusional states sometimes occur in older patients following metrizamide myelography, and coma has occurred in a few cases. The incidence of seizures shortly after myelography, originally reported to be much less than 1 in 1,000 in the European experience, is higher in the United States. This difference is probably related to the prior use in this country of isophendylate with its relatively low immediate toxicity, while European and Scandinavian myelographers were accustomed to working with aqueous contrast agents of higher toxicity, thereby developing more conservative myelographic techniques.

The combination of metrizamide and CT makes it possible to examine difficult areas using relatively low amounts and concentrations of the contrast agent, thereby decreasing the side effects. Areas where this technique is particularly helpful include the foramen magnum, cisterns about the brain stem and the suprasellar region, and investigation of syringomyelia. CT may also be used to salvage a myelographic study of the spinal canal in which the metrizamide has become too dilute for conventional filming.

Though not a perfect contrast agent, metrizamide is highly versatile and represents a significant advance over earlier myelographic contrast agents.

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Percutaneous Transhepatic Biliary Drainage

ALTHOUGH percutaneous transhepatic biliary drainage has been used for the past decade, its use has been greatly increased since angiographic catheterization techniques were applied by Ring and co-workers. These involve placement of cathe-